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FAST-GROWING HYBRID POPLARS (4, 5, 7, 10)[1] are now being tested in plantations scattered from Maine to West Virginia to find out how the different hybrids respond to a wide range of environmental conditions throughout the Northeast.

Conclusive results from these tests will not be available for several years, though progress reports will be issued from time to time as results become available. However, experiences in setting out test plantations have already provided useful information about methods of planting hybrid-poplar cuttings.

This report is based on the experience gained in establishing experimental plantations on the Hopkins Memorial Experimental Forest at Williamstown, Massachusetts--one of the several test localities in the Northeast.

[1]Underlined numbers in parentheses refer to Literature Cited, Page 9.

THE HOPKINS PLANTATIONS

Planting was started in 1949, and to date about 40,000 hybrid-poplar cuttings have been planted on some 16 acres of abandoned farm land. They represent 247 hybrid-poplar clones produced from crosses among 34 different poplar species.

The hybrids were selected from the original plantation of nearly 14,000 hybrid-poplar seedlings set out in Maine in 1927 and 1928 (7). They were selected for their exceptionally fast growth and other desirable inherent qualities as judged from their performance in the Maine plantation.

The tests now under way are designed to find out how these clones will respond to different environmental conditions. These tests are expected to show which clones can be successfully planted in the Northeast.

In choosing the best clones for widespread planting in different areas of the Northeast, the criteria on which selections will be made are: growth rate, resistance to insects and diseases, growth habit, and other desirable inherent characteristics.

PLANTING METHODS

Hybrid poplars grow best on fertile, moist, well-drained sandy sites. They will not succeed on dry sandy sites (3). Poplars started from cuttings must be kept free of grass and weeds (4, 5); this makes site preparation necessary.

Site Preparation

On open land, the entire planting area should be prepared. This eliminates grass and weeds, and permits several methods of cultivation to be used.

Fall plowing proved best on the Hopkins Experimental Forest, where the soil is a rather compact loam. By plowing before the late rains set in, the difficulties of working heavy, wet land were avoided. Fall plowing also exposed the soil to freezing and thawing during the winter. This helped to break down large clods and to kill off many of the exposed grass and weed roots.

Both single- and double-bottom plows proved effective. Plowing along the contour or across the slope lessened the danger of erosion. A two-way plow was more efficient on slope sites than a one-way plow. A single-bottom plow was more effective on brushy sites than a double-bottom plow since there was less chance for vegetative trash to lodge in the single plow share.

As soon as the land can be worked in the spring, it should be worked with a disk harrow to pulverize the soil, level it for planting, and discourage early-starting weeds. If the soil is crumbly, two harrowings will suffice.

On brushy sites, where the cost of preparing and maintaining the entire area would be exorbitant, strips are prepared for planting. The strips are at least 5 feet wide--wide enough to accomodate a single-row, straddle-type cultivator--and they are spaced 10 to 12 feet apart.

A heavy rototiller (Seaman) was the most effective equipment tested for preparing brushy land. It was particularly good for preparing narrow planting strips for the pilot plantations on both open and brushy land. The unit tested had rear-mounted, rotating teeth powered by a self-contained motor; however, it had to be pulled along the ground by a tractor. As it was pulled over the ground, the rotating teeth chewed, shredded, mixed, and spread the soil and surface vegetation over a strip 5 feet wide. No harrowing was required; the rototiller leveled the ground as it worked.

The quality of the work depended on the number of times the ground was worked, the character of the plant cover on the site, and the condition of the machine's teeth. At least two trips were needed to prepare brushy land satisfactorily. On open sod land only one trip was required. As teeth wore down, the quality of the work deteriorated.

The quantity of work done in a given period of time depended more on motive power and traction and, to some extent, on terrain, than on ground cover. A medium-size crawler tractor proved superior to a large farm-type wheel tractor for pulling this large rototiller--under all conditions. Brush, represented on the forest by wild spirea and trees less than 2 inches in diameter, did not interfere with rate of travel, but did materially affect the quality of the work.

Although disk plows have not been tested on the forest, favorable reports on their use at other places (2) in-

dicate that they may have a place in preparing land for hybrid-poplar plantations.

Three other methods tested were found to be unsatisfactory for preparing land for planting hybrid-poplar cuttings:

Bulldozing.--Scraping brush and surface vegetation off with a bulldozer was costly and unsatisfactory. Nutritive top soil was lost. The exposed, heavy, clayey undersoil baked hard in summer and heaved in winter. Mortality was high, and the survivors showed poor vigor.

Burning.--Attempts to burn off brush, even on high-hazard days in the spring, were unsuccessful. Burns were spotty and too light to be effective. The only apparent result was a slight reduction in density of the brush cover.

Bog harrow.--A heavily weighted bog harrow, pulled with a light crawler tractor, knocked brush down and partially ground it into the soil. Areas so treated were satisfactory for planting conifers where no subsequent cultivation would be needed. But this treatment was not satisfactory for hybrid poplars.

Planting

Hybrid-poplar cuttings should be spaced as closely as cultivating equipment will permit so that crown closure will shade out grass and weeds early in the life of the plantation. For the South, Maisenhelder (2) suggests spacings from 6 x 9 feet to 9 x 9 feet for cottonwood cuttings. For the North, where growth rates are slower, spacings of 4 x 4 feet to 6 x 6 feet are used. In strips spaced 12 feet apart, cuttings are planted from $2\frac{1}{2}$ to 3 feet apart in the row. This closer spacing in strip plantings is insurance against losses due to less intensive cultivation.

Cross-marking the field before planting is desirable when cross-cultivating is planned. It assures uniform spacing in both directions and lessens the danger of damaging or uprooting cuttings during cultivation. Any suitable agricultural marking device, set for the desired spacing, can be used.

All planting on the experimental forest was done in the spring when the ground was moist. Unrooted, dormant, 12-inch hybrid-poplar cuttings were used. They were graded from 3/16 to $\frac{1}{2}$-inch middle diameter.

A foot dibble was used for planting. The cutting was put into the dibble hole base-end first, and was pressed down firmly until only two buds were left exposed. Using his heel, the planter tamped the earth firmly around the cutting.

Cultivation

Cultivation is essential to control weeds and grass (4, 5, 6), at least during the first growing season. Cultivating not only controls weeds, but also conserves moisture. Where soils are light and shallow, and growth rates are slow, cultivation may be necessary during the second growing season too.

To be effective, cultivation must be frequent enough to keep grass and weeds out. Low weeds and grass inhibit hybrid poplars as much as overtopping weeds. For greatest efficiency, the work should be done while the weeds are small. If the weeds are large, equipment is less effective, planted trees are often damaged or uprooted, and much hand work is required to supplement the machine work and to uncover buried trees. On the Hopkins Forest, weeds have been controlled by scheduling the first cultivation for 2 weeks after planting, and cultivating thereafter at monthly intervals for a total of three cultivations.

Hot, dry periods are ideal for cultivating. Then the earth is dry and crumbly and much of it falls off the grass and weed roots, exposing them to the drying action of the hot sun. Equipment operates at greatest efficiency then. Wet periods favor weed growth, hamper the use of equipment, and increase the number of cultivations needed for adequate weed control.

Plantations can be cross-cultivated, cultivated in one direction only, or hand weeded. The choice of method depends largely on spacing, method of site preparation and--to a considerable extent--on type of equipment available.

Where spacing was uniform in both directions, cross-cultivating was the most effective machine method. Little or no supplemental hand work was needed. (Here in the Northeast, where labor is expensive and not always available, every effort is made to keep the need for hand work as low as possible.) Where the trees were closely spaced in rows in prepared strips--as in the pilot plantations--machine cultivation was done only in one direction.

Both disk and tooth cultivators were used on the plantations. Where large amounts of vegetative trash in the

form of unmowed grass, brush stems, root clumps, and other long-stemmed material lay on, or slightly below, the ground surface, the disk cultivator was better than the toothed cultivator because it either cut through this material or rode over it. A tooth cultivator often hooked into this trash and dragged it over the ground, damaging the planted trees.

Whether to use a between-the-row or a straddle-row cultivator depends upon spacing, height of the trees, and on the personal choice of the operator.

Farm tractors equipped with widely spaced front wheels were steered more easily along the rows and did less damage to the trees when cultivating in wet places than those equipped with small, closely-spaced front wheels.

COSTS

The costs of establishing these test plantations reflect experimental conditions; so they cannot be used directly to estimate costs for a commercial operation. However, certain valid conclusions can be drawn from these data, and they may be useful.

In addition to wage and equipment rates, the cost of establishing such hybrid-poplar plantations will vary with local conditions such as the condition of the planting site, intensity of site preparation, spacing, frequency and intensity of cultivation, and type of equipment used.

Condition of the planting site affects cost, particularly cost for site preparation. For example, the cost of preparing brushy land for planting with a rototiller will be about double that of preparing open sod land, because at least two trips are needed to prepare it as well as can be done in one trip on open land. If a thorough job is done, later planting and cultivating costs will be no greater than on open sod land. Wet conditions--particularly on heavy, compact soils--also affect costs by decreasing equipment efficiency.

The cost of setting out plantations of hybrid-poplar cuttings, although greater than for conifer plantations, compares favorably with the cost of setting out plantations of hardwoods. Methods of establishing hybrid-poplar plantations are essentially the same as for plantations of other hardwoods (8, 9). Faster growth rates, ability to reproduce from cuttings, and a strong sprouting capacity favor hybrid-poplar plantings.

Cultivation proved to be a costly operation in maintaining the experimental plantations. So far no satisfactory substitute for cultivation has been found (1).

Experiences with these experimental plantations indicate that a farmer should be able to prepare open sod land, plant hybrid-poplar cuttings at a 4- by 4-foot spacing, and maintain the plantation with an expenditure of less than 22 man-hours of labor and 9 equipment-hours per acre. This kind of planting would take 2,722 trees per acre.

He could lower costs by preparing and planting strips 6 feet wide and 12 feet apart, with cuttings planted 3 feet apart in each strip. Costs for this kind of planting should not be more than 18 man-hours and 6 equipment-hours per acre. This kind of planting would accomodate 1,210 trees per acre.

SUMMARY

The measures needed to establish plantations of hybrid-poplar cuttings have been pretty well developed. Requirements for success are:

- Fertile, moist, well-drained sandy soils.
- Complete plowing and harrowing of the ground prior to planting.
- Cultivation to control weeds, at least during the first growing season.

Generally, the ordinary agricultural equipment of the kind found on most farms can be used to prepare the land and to cultivate for weed control.

On brushy planting sites, where the cost of preparing and maintaining the entire space between the rows would be exorbitant, narrow planting strips, spaced 10 to 12 feet apart, are being tried.

A heavy rototiller has been found more effective than plow and harrow and less costly for preparing such strips on both open and brushy land.

Close spacing, to obtain crown closure that will shade out grass and weeds early in the life of the plantation, is recommended.

Where cross-cultivation with machinery is planned, fields should be cross-marked prior to planting to assure uniform spacing in both directions. Otherwise, marking may be omitted.

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